JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Studies on Phytochemical and Pharmacological profile of Cassia tora Lin: An Overview

Dilip K. Ahire
Dept of Zoology, P.V. P. College, Pravaranagar, At- Loni- 413713, Ahmednagar, MS.
(Affiliate to Savitribai Phule Pune University, Pune, MS)

ABSTRACT

Cassia tora is a small shrub budding as weed in Asian and African countries. These plat are edible leafy vegetable taken up by Asians. *Cassia tora L.* is one of the well-known anthraquinone containing plant and has been used in Chinese, Ayurvedic medicine. From time immemorial, different parts of *Cassia tora* have found application in Indian and Chinese medicine. It is various useful medicinal effects are well documented in the many publications. In these present review, an attempt has been made to explore a literature survey on its traditional uses, phytochemical studies, pharmacological properties. The whole plant such as some plant parts roots, leaves and seeds have been widely used and claimed against different diseases by rural and traditional facilator of Satana region of Maharashtra. Cassia tora plant has great contribution in the modern system of the herbal medicines for new drug development.

Keywords: Ayurvedic medicine, Anthraquinone, Cassia tora, Foetid Cassia, Pharmacological properties, Satana region.

INTRODUCTION

The medicinal use of natural products which are derived from natural sources like plants, animals or micro-organisms was recorded in human history since thousands of years. In the Zagros Mountains of Kurdistan in Iraq, more than 60,000 years ago, evidence of pollen deposits in one of the graves has been recorded. These Paleoanthropological studies indicated that Neanderthals might have been aware of the medicinal values of diverse plants [1]. Medicinal plants are known the oldest health curing agents. These are documented in health management system by two ways, first the one is traditional system of medicine and another is modern system of medicine. In the traditional system of medicine, various medicinal plants have been documented in different indigenous systems for different disorders. Now-a-days, the Ayurvedic system of medicine is widely accepted and practiced by many pharmaceuticals not only in India but also in developed countries like Europe, Japan, China, Canada etc. [2]. Cassia tora is a small shrub plant grows up in warm moist soil tropical parts of Asian and African countries. These plant are different names in different places like wise Foetid Cassia tora, Sickle Senna, Wild Senna, Sickle Pod, Coffee Pod, Tovara, Chakvad, Ring-worm Plant. These plant has 10 cm long pinnate leaves, each leaf has three pairs of leaflets that are opposite, ovate, oblong and oblique at the base. The yellow-colored flowers are bearded in the of the leaves. The flowers is consist of half inch diameter five petals. The seeds of C. tora are rhombohedral and brown in color. The *C. tora* gets flowers in the rainy season and these plant fruits in the winter season. These plant leaves, seed, roots are utilized as food ingredients since long [3]. The traditional herbal medicines are still practices large part of our country mostly in tribal areas. In many developed countries large section of population relies on traditional practioners, who are dependent on herbal folk medicines for their primary health care and has deep faith in it. Since the usages of these herbal medicines are increased, the issues regarding their safety, quality and efficacy in industrialized and developing countries are cropped up [4]. Presently both common consumers and health care professional seek updated, authoritative information towards safety and efficacy of any recommended medicinal plant as drug prior to its use [5,6,7]. In India it occurs as wasteland rainy season weed, grows in dry soil throughout tropical parts and high hills of elevations up to 1,800 m as well as in

plains [8]. The plant is herbaceous foetid herb, almost an under-shrub, up to 30-90 cm high, with pinnate leaves.Leaflets are in 3 pairs, opposite, obovate, oblong with oblique base and up to 10 cm long. Flowers in the pair in axils of leaves with five petal and paleyellow colour. In Indian climates, the flowering time is favourable after the monsoon rain. Pods is flattened or four angled, 10 to 15 cm long and sickle shaped, hence the common name sickle-pod. The seeds are 30-50 in a pod, rhombohedral and gathered in autumn and dried in sun [9]. The present review and compile updated information on various aspects of C. tora plant used of medicine for variety of purposes. Ghete are the it highlights the several epidemiological, pharmacological and experimental studies on it, which demonstrated the correlation between the active constituents and uses in different fields.

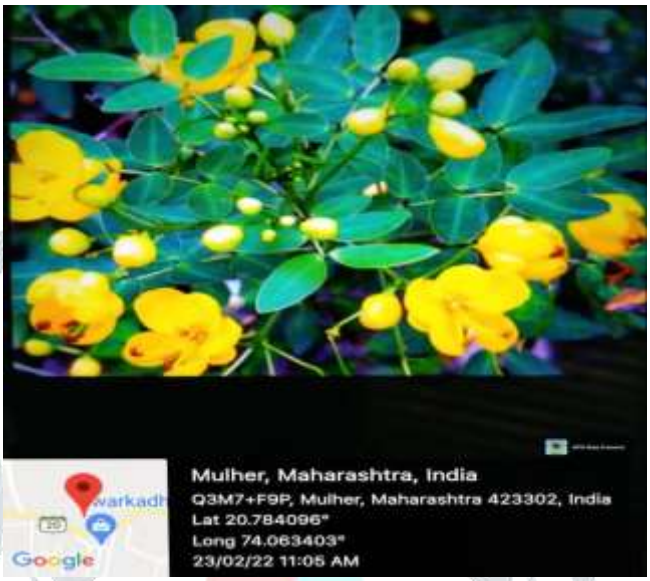

Figure 1: Plant of Cassia tora

Figure 2: Seeds of Cassia tora

Phytochemical Studies:

Seeds:

These plant Seeds contain there are different amino acid, fatty acids, aloe-emodin, chrysophanol, emodin, rhein and sitosterol. Chrysophanic acid and its 9-anthrone derivative were also isolated from the seeds. There are Rubrofusarin and triglucoside, 6-O-β-D-glucoside, and 6-O-β-D-gentiobioside; norrubrofusarin and its gentiobioside, torachrysone and its gentiobioside, teraglucoside, apioglucoside, demethylflavasperone gentiobioside, obtusin, aurantio-obtusin, isotoralactone, cassia-lactone, naphthalenic lactone, quercetin were also isolated from the seeds [11]. These plants Seeds also contain anthraquinone glycoside, naptho-pyrone glycosides, cassiaside and rubrofuarin-6-beta-gentiobioside [8]. It is also yield a fatty oil consisting of oleic, linolic, palmitic and lignoceric acids and sitosterol [12]. A new anthraquinon glycoside – 8-hydroxy-3- methylanthraquinone-1-β-gentiobioside (III) are found in seeds. A water soluble polysaccharide composed of D galactose and D-mannose in molar ratio of 1:3:1 is found in seeds [Rastogi, 2006]. Two new lactones– isotoralactone and cassialactone are present in seeds along with torosachrysone [13]. Two new naphthopyrone glycoside – 9-[(β-Dglucopyranosyl(1→6)-O-β-D-glucopyranosyl)oxy]-10-hydroxy-7-methoxy-3-methyl 1H-naphthol[2,3-C]pyran-1-one (I) and 6-[(α-apiofuranosyl(1→6)-O-β-Dglucopyranosyl) oxy]-rubrofusarin (II) are also present in seeds. Analysis of the seeds gave the following values: moisture, 4.48; crude protein, 23.77; fat, 2.74; crude fibre, 13.14; carbohydrates, 48.53; ash, 7.34; iron, 0.187; and phosphorus, 0.362%. The amino acid composition of protein is as follows: lysine, 3.7; histidine, 2.4; threonine, 9.2; phenylalanine, 4.8; valine, 6.4; metheonine, 1.6; tryptophan, 0.9; leucine and isoleucine, 15.1; serine, 7.4; glycine, 10.2; tyrosine, 3.8; cystine, 0.8; arginine, 6.6; glutamic acid. Aspartic acid, 6.8; alanine, 8.4; and proline,
0.6% [14].

Leaves:

The leaves contain chrysophanol, aloe-emodin, rhein and emodin [15]. Presence of emodin and kaempferol-2-diglucoside is also reported in the leaves. The leaves also contain d-mannitol, myricyl alcohol, β-sitosterol, glucose, togonelline, 1-stachydnine and choline. Triacontan-1-ol, stigmasterol, β-sitisterol-β-D-glucoside, friedelin. Palmitic, stearic, succinic and d-tartaric acids, uridine, myo-inositol, d-ononitol, kaempferol, quercetin, juglanin, astragalin, quercitrin and isoquercitrin are also isolated from leaves [16]. Analysis of the leaves gave the following values: moisture, 82.5; protein, 4.5; fat, 1.1; fibre, 2.2; carbohydrates, 8.0; minerals, 1.7%; calcium, 520; phosphorus, 39; iron, 12.3; thiamine, 0.19; riboflavin, 0.83; nicotinic acid, 0.83; vitamin C, 82 mg/100g [17].

Roots:

Root contain choline, 1,3,5-trihydroxy-6, 7-dimethoxy-2 methylanthraquinone, leucopelargonidin-3-O-α-L-rhamnopyronaside and β-sitosterol [18].

Pharmacological Use

Anti-Oxidant Activity:

Several diseases/disorders are associated to oxidative stress caused by free radicals [19,20]. Antioxidants behave as a key defense system against free radical mediated toxicity by protecting the damages [21]. Anti-oxidants can act as free radical scavengers, lipid peroxidation inhibitor and savior to other free radical mediatedprocesses, protecting the human organs against several pathologies such as Parkinson's disease, atherosclerosis, Alzheimer's disease and cancer [22]. Scalbert et al. (2005) was suggested that polyphenols may protect cell ingredients against oxidative damage and, by that mean they limit the risk of various degenerative diseases associated with oxidative stress [23]. The polyphenolic content of C. tora is the high (3.7g kg−1) in dried leaves. The keeping the fact of rich polyphenolic content in dry leaves of C. tora, in the mind and evaluated the nitric oxide scavenging activity of methanolic leaves extract of these plant. The extract wasalso studied for the its lipid peroxidation inhibition assay using the rat liver and brain. Methanolic leaves extract of these plant show better nitric oxide scavenging activity when the to Rutin, so it can be used to minimize or retard the damage from nitric oxide radicals. The methanolic leaves extract of C. tora is very effective in inhibiting lipid peroxidation also [24].

Hypolipidemic Activity:

The ethanolic extract of the seeds of C. tora and it is fractions were examined for hypolipidemic activity on triton induced hyperlipidemic profile in Albino rats. Ethanolic extract and its ether soluble and water soluble fraction decreased the serum level of total cholesterol, LDL-cholesterol and triglyceride while slightly increased the HDL-cholesterol level [25,26]. Supplemented, a mixture of C. torafiber consisting of 2 g, 200 mg of alpha-tocopherol, 500 mg of ascorbic acid and 300 mg of maltodextrin to type II diabetic patients for 2 months. They observed that the level of serum total cholesterol, triglycerides and LDL-cholesterol declined in these plant group compared with the age and gender matched placebo group, while theFasting blood glucose, HbA1c, blood urea, creatinine

and activities of serum Aspartate Aminotransferase (AST) and alanine Aminotransferase (ALT) were not altered [27].

Antinociceptive and Spasmogenic Activity:
These activity of a methanolic extracts of leaves of C. tora was the evaluated in mice by Chidume et al. The extract reduced nociceptive response of mice to the force in a dose-dependent manner. The same extracts of C. toraalso have spasmogenic effects. The extract elicited contraction of smooth muscles of guinea pig ileum and rabbit jejunum in a concentration-dependent manner [28].

Antitumor activity:
The emodin (1, 3, 8-trihydroxy methylanthraquinone) is a naturally occurring anthraquinone present in the roots and barks of C. tora as an active ingredient. It's role in combination chemotherapy with standard drugs to reduce toxicity and to enhance efficacy is pursued vigorously. Its additional inhibitory effects on angiogenic and metastasis regulatory processes make emodin a sensible candidate as a specific blocker of tumour associated events. Additionally, because of its quinone structure, emodin may interfere with electron transport process and in altering cellular redox status, which may account for its cytotoxic properties in different systems. This biological property of emodin molecule is offering a broad therapeutic window, which in future may become a member of anticancer [29].

Antifungal activity:
Mukherjee PK et al determined the antifungal activity of the dealcoholized extract of Cassia tora leaves against different fungal organisms. Standard antifungal agent griseofulvin was used to compare the effect produced by leaf extract. Study showed the significant inhibition growth of C.albicans, A.niger, S.cerevistiae, and T.mentagophytes when crude leaf extract was tested by turbidity and spore germination methods in concentration dependent manner [30]. In another study, Young-Mi Kim et al determined the fungicidal activities of Cassia tora extract and their active principles against Botrytis cineria, Erysiphe graminis, Phytophthora infestans, Puccinia recondite, Pyricularis grisea and Rhizoctonia solani in vivo. Results were compared with Chlorothalonil and dichlofluanid as synthetic fungicides and three anthraquinone that are commercially available. Isolated emodin, physcion and rhein showed fungicidal activities against B. cineria, E. graminis, P. infestans and R. solani. Also aloe-emodin showed strong fungicidal activitie against B. cineria while moderate against R. solani and no activity against E. graminis, P. infestans, P. recondite and Py. Grisea [31].

Antibacterial activity:
Torachrysone, toralactone, aloe-emodin, rhein and emodin isolated from the seeds showed noticeable antibacterial effects on four strains of methicillin resistant Staphylococcus aureus with a minimum inhibitory concentration of 2-64 mg/ml. On the other hand, some phenolic glycosides were also isolated from seeds that did not show strong antibacterial effects on Escherichia coli and P. aeruginosa [32].

Anthelmintic activity:
Deore S. L. et al investigated anthelmintic activity of alcohol and aqueous extracts from the seeds of Cassia tora against Pheretima posthuma and Ascardia galli. Each extract was used in concentration of 25, 50 and 100 mg/ml which involved the determination of time of paralysis and time of death of the worm. The earthworms (Pheretima posthuma) of 3-5 cm in length and 0.1-0.2 cm in width were used for all the experimental protocol. Six groups of earthworm having six earthworms in each were released in to 50 ml of solutions of piperazine citrate, aqueous and alcoholic extracts of seeds of Cassia tora (29, 40 and 80 mg/ml each) in distilled water. Same experiment was done for Ascardia galli worms only the difference was solutions were prepared in normal saline solutions instead of distilled water. The alcoholic seed extract of Cassia tora demonstrated paralysis as well as death of worms in a less time as compared to piperazine citrate especially at higher concentration of 80 mg/ml. While water extract also showed significant activity [33].

Antimutagenic activity:
Antimutagenic activity of anthraquinone aglycones and naphthopyrone glycosides from a methanolic extract of seeds against aflatoxin B1 (AFB1) was demonstrated with the Salmonella typhimurium assay. The MeOH extract was then sequentially partitioned with CH_2Cl_2, n-BuOH and H_2O. The CH_2Cl_2 and n-BuOH fractions possessed antimutagenic activity but the H_2O fraction was inactive. Neither the MeOH extract nor its fractions were capable of inhibiting the direct-acting mutagen N-methyl-N′-nitro-N-nitrosoguanidine suggesting that these fractions may prevent the metabolic activation of AFB1 or scavenge the electrophilic intermediate capable of inducing mutations. Column chromatography using silica gel yielded pure chrysophanol, chryso-obtusin and aurantio-

obtusin from the CH2Cl2 fraction and cassiaside and rubro-fusarin gentiobioside from the n-BuOH fraction. Each of these compounds showed significant antimutagenic activity [34].

Antigenotoxic Activity:
An aqueous seed extract has a dose dependent inhibitory effect on benzo[a]pyrene (B[a]P)-induced DNA damage in human hepatoma cell line HepG2 due to its anthraquinones derivatives like chrysophanol, emodin and rhein present in it. Antigenotoxicity of the drug might be decreased due to a reduction in their anthraquinones content. Aqueous extract alone, at low concentrations of (0.1-2 mg/ml) showed neither cytotoxic nor genotoxic effect toward HepG2 cells [35].

Anti-inflammatory activity:
Tapan Kumar et al carried out anti-inflammatory effect of the methanolic extract of Cassia tora leaves against carrageenin, histamine, serotonin and dextran induced rat hind paw oedema. In the study, cassia tora was found having significant anti-inflammatory activity against all these agents. The maximum inhibition of oedema was found at a dose of 400mg/kg [36]

Antihepatotoxic activity:
Protective effect of leaf extract against CCl4 induced hepatotoxicity has been reported. The extract showed the ability to stabilize biliary dysfunction in rat liver during chronic hepatic injury with CCL4 [37]. In another study new antihepatotoxic naphthopyrone glycosides, 9-[β-D-glucopyranosyl- (1→6)-O-β-glucpyranosyl) oxy]-10-hydroxy-7-methoxy-3-methyl-1H-naphtho [2,3-c] pyran-1–one and 6-[(α-apiofuranosyl-(1→6)-O-β-D-glucopyranosyl) oxy]-rubrofusarin, together with cassiaside and rubro fusarin-6-β-gentiobioside were isolated from the seeds showed the significant hepatoprotective effects against galactosamine damage, which were higher than that of silybin from Silybum marianum Gaertn [38].

Antinociceptive activity:
The methanolic extract of leaves showed the antinociceptive and smooth muscle contracting activities and spasmogenic effects on guinea pig ileum, rabbit jejunum and mice intestinal transit in a concentration-dependent manner which is reversibly blocked by Atropine. Mepyramine also reduced the contractile amplitude due to the extract. The extract increased intestinal transit in mice dose dependently. C. tora extract significantly reduced the number of acetic acid induced abdominal constrictions in mice and the effect was comparable to that of Aspirin. The extract also significantly reduced the nociceptive response of mice to increased force (g), which is dose-dependent. Thus the use of C. tora traditionally as a purgative and in the treatment of other ailments is justifiable [39].

Hypotensive activity:
The seeds of C. tora elicit hypotensive effects in anesthetized rats. Experimental results indicate that the hypotensive effect of the extract possibly involves a vagal reflex, which reciprocally alters the vasomotor tone of the centrally emanating sympathetic nervous system [40]. A study by Koo et al on pentobarbital-anesthetized rats revealed that the medial portion of the medullary reticular formation is directly involved in the hypotensive effect of extracts. The role of the medullary reticular formation in the C. tora induced hypotension was suggested to be one, which modulates the basic cardiovascular reflexes, favouring a decrease in vasomotor tone [40].

Hypoglycemic activity:
Jeongsu Nam and Hyunju Choi studied the effects of Cassia tora L. seed butanol fraction (CATO) on postprandial glucose control and insulin secretion from the pancreas of the normal and diabetic rats. Adult male Sprague-Dawley rats, weighing 330-390 g, were used for the study. Diabetes was induced by intraperitoneal injection of Streptozotocin at a dose of 55 mg/kg body weight. Rats showing above 300 mg/dL of 12 hours fasting serum glucose level were used for the diabetic groups. The postprandial glucose control was monitored during a 240 min-period using a maltose loading test. In normal rats, rats fed CATO (20 mg/100 g BW/d) showed lower postprandial glucose levels in all the levels from 30 min up to 180 min than those in the control rats without CATO. Findings indicated that constituents of Cassia tora L. seeds have beneficial effect on postprandial blood glucose control which may be partially mediated by stimulated insulin secretion from the pancreas of the diabetic rats [41].

Purgative activity:
Maity TA and Dinda SC evaluated the purgative activity of the methanolic extract and aleo-emodin isolated from the Cassia tora leaves in male wistar rats weighing between 150-180 gm. The purgative action of crude extract (100mg and 200mg/kg P.O) and material isolated from cassia tora leaf (20mg/kg P.O) was compared with the

standard drug, sennoside (7.5 mg/kg P.O). The results obtained were comparable to that of standard purgative drug sennoside [42].

Anti-Proliferative Activity:

The anti-proliferative potential of C. tora methanolic extract of leaves with Cisplatin, anticancer drug in human cervical cancer cells (HeLa). This study confirmed that C. tora methanolic extract strongly inhibited the growth of human cervical cancer cells [43].

Anti-Diabetic Activity:

The hypoglycemic activity of C. tora has been reported by many scientists. Nam and Choi (2008) studied the effects of C. tora L. seed butanol fraction (CATO) on postprandial glucose control and insulin secretion from the pancreas of the normal and streptozotocin induced diabetic rats. They observed that in normal rats fed with CATO have lower postprandial glucose levels. In diabetic rats, the levels in the CATO fed group have lower postprandial glucose during the 30~180 min. When CATO was given orally to the diabetic rats for 5 days, the 12 hr fasting serum glucose level was diminishd in the diabetic rats. The decrease in 12 hr fasting serum insulin level was less in the diabetic CATO rats than diabetic control rats. The findings of this study indicated that components of C. tora L. seeds have favorable effect on postprandial blood glucosecontrol which may be partially mediated by stimulated insulin secretion from the pancreas of the diabetic rats [44].

Immunostimulatory Activities:

In a study by Cherng et al. (2008) the immunostimulatory activities of four anthraquinones of C. tora (aloe-emodin, emodin, chrysophanol and rhein) on human Peripheral Blood Mononuclear Cells (PBMC) were evaluated. The results mentioned that at non-cytotoxic concentrations, the anthraquinones were effective in stimulating the proliferation of resting human PBMC and/or secretion of interferon-γ (IFN-γ). Nevertheless, at the concentration of 10 ng mL−1, rhein significantly stimulated proliferation of resting human PBMC, but inhibited IFN-γsecretion [45].

CONCLUSION

This review is a mini compendium of the effects of different parts of C. tora in various biological systems. It is also a summary of the potential health benefits of this wonder plant and should help advance research to further explore the useful impact of this plant/extract of differential parts of the plant in various chronic pathological conditions. It appears that literatures are scanty as far as toxicology of the various extracts of this plants concerned. Therefore, it is an urgent need to standardize the toxic properties/medicinal properties of C. tora and qualitative examination of the phytochemicals extracted from it for further use as an alternative therapy. Cassia tora is the important valuable plant for skin diseases and other disorders. As per USM, seeds are useful in leprosy, ringworm, pityriasis, vitiligo and melasma internally as well as externally. Scientific studies also proved some of USM claims and moreover these studies also proved that the seeds and leaves of this plant may be used for hypolipidemic activity, hypoglycemic activity, anthelmintic activity, antimutagenic activity, antifungal activity, hepatoprotective activity, purgative activity, anti-inflammatory activity, antioxidant activity and antimicrobial activity.

REFERENCES

1. Solecki, R. S. (1975). Shanidar IV, A Neanderthal flower burial in northern Iraq. Science. 190: 880–881.
2. Rao, K. V., Venkanna, N. and Lakshmi, N. M. (1998). Agrobacterium rhizogenes mediated transformation of Artemisia annua. J. Sci. Ind. Res. 57:773-776.
3. Meena, A. K. Bansal, P. and Kumar, S. (2009). Plants herbal wealth as a potential source of ayurvedic drugs. Asian Journal of Traditional Medicine. 4(4): 152-170.
4. Ingle, A., P. Ranaware, A. Ladke and M. Damle, 2012. Cassia Tora: Phytochemical and pharmacological activity. Int. Imperial J. Pharmacognosy Natural Products, 2: 14-23.
5. Anonymous, WHO monograph on medicinal plants, World Health Organization, Geneva, 1999, Vol.-1, pp. 1-2
6. Lavhale Manish and Mishra SH, Nutritional and therapeutic potential of Ailanthus excelsa-A Review, Phcog Rev, 2007, 1(1), 105-113.
7. Kiew R and Baas P, Nyctanthes is a member of Oleaceae, Proc Indian Acad Sci Plant Sci, 1984, 93(3), 349-358.
8. Chatterji A, Pakrashi SC. The treatise of Indian medicinal plants. Vol. II. New Delhi: CSIR; 2006:44-6.
9. Deore SL, Khadabadi SS, Kamdi KS, Ingle VP, Kawalkar NG, Sawarkar PS, Patil UA and Vyas AJ, In vitro anthelmintic activity of Cassia tora, Chem Tech, 2009, 1(2), 177-179.

10. DS, Lee GY, Kim YS, Lee YM, Kim CS, Yoo JL and Kim JS, Anthraquinones from the seeds of Cassia tora with inhibitory activity on protein glycation and aldose reductase, Biol Pharm Bull, 2007, 30(11), 2207-2210.
11. Rastogi RP, Mehrotra BN. Compendium of Indian medicinal plants. Vol. V. New Delhi: CSIR; 2005: 176.
12. Umesh KP, Saraf S, Dixit VK. Hypolipidemic activity of seeds of Cassia tora Linn. Journal of Ethnopharmacology 2004; 90: 249-52.
13. Sirappuselvi S, Chitra M. In vitro Antioxidant Activity of Cassia tora Lin. International Research Journal of Biological Sciences 2012 Oct; 1(6): 57-61.
14. Kirtikar KR. Basu BD. Indian medicinal plants. Vol. II. Dehradun: International Book Distribuors; 2006: 878-9.
15. Khare CP. Indian medicinal plants. New Delhi: Springer (India) Privet Limited; 2007: 130.
16. Prajapati ND, Purohit SS, Sharma AK, Kumar T. A handbook of medicinal plants. Jodhpur: Agrobios; 2009: 120-1.
17. Rastogi RP, Mehrotra BN. Compendium of Indian medicinal plants. Vol. II. New Delhi: CSIR; 2006: 150.
18. Rastogi RP, Mehrotra BN. Compendium of Indian medicinal plants. Vol. V. New Delhi: CSIR; 2005: 176.
19. Gutteridge, J.M., 1993. Free radicals in disease processes: A compilation of cause and consequence. Free Radic. Res. Commun., 19: 141-158. PMID:8244084.
20. Mukherjee, S. and B. Gogoi, 2011. Free radicals in diseases and potential role of phytoconstituents-a cause with emerging importance. Curr. Chem. Biol., 5: 197-212. DOI: 10.2174/187231311796765030.
21. Lee, S.E., H.J. Hwang, J.S. Ha, H.S. Jeong and J.H. Kim, 2003. Screening of medicinal plant extracts for antioxidant activity. Life Sci., 73: 167-179. DOI: 10.1016/S0024-3205(03)00259-5
22. Rosenkranz, H., 2002. A paradigm for determining the relevance of short term assays: Application to oxidative mutagenesis. Mutat. Res., 508: 21-27. DOI: 10.1016/S0027-5107(02)00144-6.
23. Rejiya, C.S., T.R. Cibin and A. Abraham, 2009. Leaves of Cassia tora as a novel cancer therapeutic-An in vitro study. Toxicol. Vitro, 23: 1034-1038. DOI: 10.1016/j.tiv.2009.06.010.
24. Scalbert, A., C. Manach, C. Morand, C. Remesy and L. Jimenez, 2005. Dietary polyphenols and the prevention of diseases. Crit. Rev. Food Sci., 45: 287-306. DOI: 10.1080/1040869059096.
25. Patil, U.K., S. Saraf and V.K. Dixit, 2004. Hypolipidemic activity of seeds of Cassia tora Linn. J. Ethnopharmacol., 90: 249-252. DOI: 10.1016/j.jep.2003.10.007.
26. Meena, A.K., U.S. Niranjan, A.K. Yadav, B. Singh and A.K. Nagariya et al., 2010. Cassia tora Linn:A review on its ethnobotany, phytochemical and pharmacological profile. J. Pharm. Res., 3: 557-557.
27. Cho, S.H., T.H. Kim, N.H. Lee, H.S. Son and I.J. Cho et al., 2005. Effects of Cassia tora fiber supplement on serum lipids in Korean diabetic patients. J. Med. Food, 8: 311-318. PMID: 16176140.
28. Chidume, F.C., H.O. Kwanashie, J.O. Adekeye, C. Wambebe and K.S. Gamaniel, 2002. Antinociceptive and smooth muscle contracting activities of the methanolic extract of Cassia tora leaf. J. Ethnopharmacol., 81: 205-209. DOI: 10.1016/S0378-8741(02)00079-X.
29. Wu CH, Hsieh CL, Song TY and Yen GC, Inhibitory affects of Cassia tora L. on benzo[a]pyrene-mediated DNA damage toward HepG2 cells, J Agric Food Chem, 2001, 49(5), 2579-2586.
30. Mukherjee PK, Saha K, Saha BP, Pal M, Das J. Antifungal Activities of the Leaf Extract of Cassia toraLinn. (Fam. Leguminosae). Phytotherapy Research 1996 Feb; 10(6): 521-522.
31. Young-Mi Kim, Chi-Hoon Lee , Hyo-Gyung Kim , Hoi-Seon Lee. Anthraquinones Isolated from Cassia tora (Leguminosae) Seed Show an Antifungal Property against Phytopathogenic Fungi. Journal of Agriculture and Food Chemistry 2004 Sept; 52(20): 6096–6100.
32. Yen GC and Chung DY, Antioxidant effects of extracts from Cassia tora L. prepared under different degrees of roasting on the oxidative damage to biomolecules, J Agric Food Chem, 1999, 47(4), 1326-1332.
33. Deore SL, Khadabadi SS, Kamdi KS, Ingle VP, Kawalkar NG, Sawarkar PS. In vitro Anthelmintic activity of Cassia tora. International Journal of Chem Tech Research 2009 Apr-Jun; 1(2): 177-9.
34. Kim YM, Lee CH, Kim HG and Lee HS, Anthraquinones isolated from Cassia tora (Leguminosae) seed shows an antifungal property against phytopathogenic fungi, J Agric Food Chem, 2004, 52(20), 6096-6100.
35. Solanke Pallavi, Singh Mahendra, Rathore Hemant, Sharma Anjali, Makwana Mukesh and Shrivastava Sharad, An Evaluation of the Genotoxic effect of seed decoction of Cassia tora L. (Leguminosae) in Allium cepa model, Ethnobot Leaflets, 2
36. Maity TK, Mandal SC, Mukharjee PK, Saha K, Das J, Pal M and Saha BP, Studies on Anti inflammatory effect of Cassia tora leaf extract (Fam. Leguminosae), Phytother Res, 1998, 12(3), 221-223.

37. James GWL and Pickering Rw, The protective effect of a novel compound RU-18492 on galactosamine induced hepatotoxicity in rats, Arzheimittel Forschung, Drug Res, 1976, 26, 2197-2199.
38. Clauson GA, Mechanism of carbon tetrachloride hepatotoxicity, Immun Pathol Res, 1989, 8, 104-112.
39. Deore SL, Khadabadi SS, Kamdi KS, Ingle VP, Kawalkar NG, Sawarkar PS, Patil UA and Vyas AJ, In vitro anthelmintic activity of Cassia tora, Chem Tech, 2009, 1(2), 177-179.
40. Koo A, Chan WS and Li KM, A possible reflex mechanism of hypotensive action of extract from Cassia tora seeds, Am J Chin Med, 1976, 4(3), 249-255.
41. Nam J, Choi H. Effect of butanol fraction from Cassia tora L. seeds on glycemic control and insulin secretion in diabetic rats. Nutrition Research and Practice 2008; 2(4): 240-6.
42. Maity TK, Dinda SC. Purgative activity of cassia tora leaf extract and isolated aloe-emodin. Indian Journal of Pharmaceutical Sciences 2003 Feb; 93-95.
43. Rejiya, C.S., T.R. Cibin and A. Abraham, 2009. Leaves of Cassia tora as a novel cancer therapeutic-An in vitro study. Toxicol. Vitro, 23: 1034-1038. DOI: 10.1016/j.tiv.2009.06.010.
44. Nam, J. and H. Choi, 2008. Effect of butanol fraction from Cassia tora L. seeds on glycemic control and insulin secretion in diabetic rats. Nutr. Res. Pract., 2: 240-246. DOI: 10.4162/nrp.2008.2.4.240.
45. Cherng, J.M., W. Chiang, J.H. Wang, C.M. Lin and C.M. Shin et al., 2008. Anthraquinones of edible wild vegetable Cassia tora stimulate proliferation of human CD4+T lymphocytes and secretion of interferon-gamma or interleukin 10. Food Chem., 107: 1576-1580. DOI: 10.1016/j.foodchem.2007.10.005